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Title: HAND-HELD HAMMER TOOL ;

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ABSTRACT:

A hand-held electrically powered hammer tool with a rotor-type electromotor (17) and a hammer mechanism (14) arranged in a machine housing (13). The hammer mechanism (14) includes a drive shaft (24) with an excentric crank pin (35) thereon for a piston rod (43) connected to a drive piston (40) reciprocably movable in a cylinder (42) for driving a hammer piston (41) towards a working tool (16) via an air cushion (44) between the two pistons. The drive shaft for the hammer mechanism (14) is also the rotor shaft of the electromotor (17) so that the hammer mechanism and the motor are driven by the same speed. The electromagnetically active parts (23,49) of the rotor (18) are located outside of and surround the corresponding parts (21, 22) of the electromotor stator (19) thus enabling the rotor also to be a flywheel and a fanwheel.

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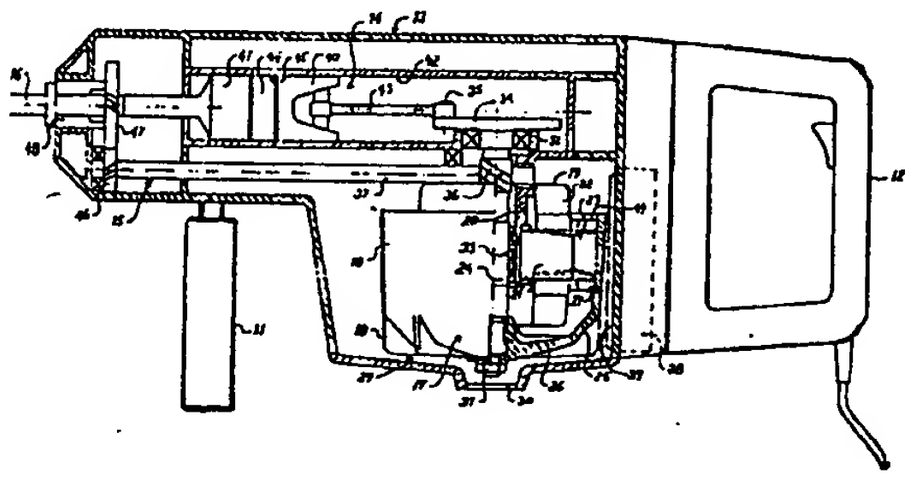
(54) A hand-held hammer tool.

(57) A hand-held electrically powered hammer tool with a rotor-type electromotor (17) and a hammer mechanism (14) arranged in a machine housing (13). The hammer mechanism (14) includes a drive shaft (24) with an excentric crank pin (35) thereon for a piston rod (43) connected to a drive piston (40) reciprocably movable in a cylinder (42) for driving a hammer piston (41) towards a working tool (16) via an air cushion (44) between said pistons. The drive shaft for the hammer mechanism (14) is also the rotor shaft of the electromotor (17) which means that the hammer mechanism and the motor are driven by the same speed. The electromagnetically active parts (23, 49) of the rotor (18) are located autside surrounding the corresponding parts (21, 22) of the electromotor stator (19) thus enabling the rotor also to be a flywheel and a fanwheel.



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A hand-held hammer tool

The present invention relates to a hand-held electrically powered hammer tool with a rotor-type electromotor and a hammer mechanism arranged in a machine housing, said hammer mechanism including a drive shaft with an excentric crank pin thereon for a piston rod connected to a drive piston reciprocably movable in a cylinder for driving a hammer piston towards a tool via an elastic means in a working chamber of said cylinder between said pistons.

Hammer tools of this type are known which have a gearing between the electromotor and the hammer mechanism. The gearing has enabled the high-speed series commutator motors previously used to develop a sufficient torque for driving the hammer mechanism without need of being too powerful and heavy which is particularly important for hand-held equipment. The total driving assembly including the gearing will, however, become rather spacious and heavy especially for tools in the high-power range. The gearing is also complicated and expensive to manufacture and causes often working interruptions due to overheating of unsufficiently lubricated gear parts. An additional drawback with these known hammer tools is that the electromotors have spark producing brushes which may be hazardous in inflammable or explosive atmosphere. The brushes and commutator are also exposed to hard wear since the drill dust reaches these parts.

An object of the present invention is therefore to provide a hammer tool which does not possess the above drawbacks and has a lower weight-to-power ratio than similar machines of prior art and which has a more simple and robust construction.

This object and others are achieved by providing a hammer tool according to the accompanying claims.

The invention will now be described more in detail referring to the enclosed drawing, Fig 1, which is a side view partly in section of a hammer tool according to the invention.

The tool shown in Fig 1 is designed to be hand-held by means of a front 11 and a rear 12 handle mounted on a machine housing 13. The housing 13 contains a hammer mechanism 14 and a rotary mechanism 15 for transmitting percussive and rotary action to a working tool 16 at the front end thereof. Said two mechanisms are driven by a common electromotor 17 which is a 8-polar AC asynchronous motor without brushes. The motor 17 includes a rotor 18 and a stator 19 which are carried on a tube-formed structure 20. The electromagnetically active parts of the stator are a iron core 21 and a winding 22 while the corresponding parts of the rotor are an iron core 23 and a squirrel cage 49. The rotor comprises a rotor shaft 24 which constitutes the drive shaft for the hammer mechanism 14 which thus is driven with the same number of revolutions as the rotor itself. The rotor also comprises a bowl-shaped body 25 with a bottom 26 and a cylindrical wall 27 on the inside of which the electromagnetically active iron core 23 is attached. The outside of the bottom 26 is shaped with radially extending fan blades 28 together forming a centrifugal fan 29 with an inlet 30. The fan 29 is adapted for cooling both the motor 17 and the hammer mechanism 14. The bowl-shaped body 25 and the rotor shaft 24 are connected to each other by a screw joint 31 in the center of the bottom 26. The rotor shaft 24 is carried of the structure 20 by a front 32 and a rear 33 bearing and is integrally shaped with a disc shaped crank 34 which has an excentric crank pin 35 for transferring the driving movement to the hammer mechanism 14. The rotor shaft 24 also comprises a worm screw 36 for transmitting rotary movement to the rotary mechanism 15 by a worm wheel, not shown, on a drive shaft 37 included in said mechanism 15. As an alternative to this worm gearing a conic gearing can be used including a bevel gear wheel mounted on each of the shafts 24 and 37.

The 8-polar asynchronous motor 17 is connected to an external electric power source, normally the mains supply, via an electronic converter 38 located between the rear handle 12 and the machine housing 13. The electronic components of the converter are attached to the wall of the machine housing which comprises cooling flanges 39 in that area.

The fan 29 blows an air stream along the wall with the flanges 39 thus also cooling said electronic components. The converter 38 which for example is of the kind described in CH patent application 8097/81 is arranged for transferring low frequency 50-60 Hz voltage of the mains supply to motor voltage of high frequency about 200 Hz and for controlling the generated power of the motor 17.

The hammer mechanism 14 is of a kind previously known for example by the US patent 3,939,921 and will therefore be described only shortly. The mechanism thus includes in addition to said crank 34 a drive piston 40 and a hammer piston 41 arranged in a cylinder 42. The drive piston 40 is reciprocably movable in the cylinder 42 by means of a connecting rod 43 connected to the crank pin 35. The drive piston 40 drives the hammer piston 41 against the working tool 16 or the tool holder via a compressed air cushion 44 in a working chamber 45 between said pistons 40 and 41. When the hammer tool is used for drilling holes the necessary removal of drill cutting is achieved by leading flushing air to a flushing channel in the drill for example by the same way as been described in the US patent mentioned above.

The rotary mechanism 15 comprises said worm gear 36, said drive shaft 37 and a gear wheel 46 mounted on the shaft 37, which wheel 46 cooperates with cogs 47 on a drill sleeve 48. A sliding clutch, not shown, is incorporated in the sleeve 48 for disengaging the drill rotation for example if the drill tool 16 is stuck in the drill hole. The sliding clutch can also be arranged in connection with the worm gear 36 for example in the way disclosed in the US patent 3,924,691.

The hammer mechanism 14 is as been described above directly coupled to the rotor shaft 24 which means that the motor speed must be adapted to the desired speed of the hammer mechanism 14 which is about 3000-4000 revolutions per minute for these kinds of tools. It might therefore seem natural to use a 2-polar asynchronous motor which would adopt such a speed when fed from the mains with a

standard frequency of 50-60 Hz. A motor of that kind must, however, be chosen spacious and heavy to achieve the necessary driving force of the hammer mechanism. By instaed chosing a multi-polar, preferably 8-polar, asynchronous motor, which by means of the converter can be given a sufficient speed, the motor size can be limited with retained sufficient drive force. The converter also makes it possible to continously adopt the speed to existing different external drilling conditions of the hammer mechanism for example when collaring a hole or when drilling in alternating hard and soft material. Further the motor can be started and accelerated to full speed without any risk for overheating because of the fact that the frequency and the motor voltage can be adopted to the instantaneous load conditions experienced by the motor.

Since the motor is a so called external pole motor with the rotor located outside the stator, the rotor can produce a sufficient flywheel moment to counterbalance the load variation under each revolution depending on the compression and expansion of the air cushion. This will exclude the need for a separate balance wheel and will in addition give a compact motor design with a short length and a possibility to integrate the fan in the rotor.

The hammer tool according to the described example is primarily adapted for percussive drilling but there is also possible to separately drive the hammer or rotary mechanism. The hammer mechanism can for example be disconnected by ventilating the working chamber 45 by the same way as been described in said US patent 3,939,921 while the rotary mechanism can be disconnected as appearing from said US patent 3,924,691 or by suitable device for declutching the gear wheels 46 and 47 from each other.

The invention is of course not limited to the described example but can be varied in many ways within the scope of the accompanying claims.

Claims:

1 A hand-held electrically powered hammer tool with a rotor-type electromotor (17) and a hammer mechanism (14) arranged in a machine housing (13), said hammer mechanism (14) including a drive shaft (24) with an excentric crank pin (35) thereon for a connecting rod (43) connected to a drive piston (40) reciprocably movable in a cylinder (42) for driving a hammer piston (41) towards a working tool (16) via an elastic means (44) in a working chamber (45) of said cylinder between said pistons, characterized in that said drive shaft (24) for the hammer mechanism is direct coupled with the rotor-shaft of the electromotor (17) and that the electromagnetically active parts (23, 49) of the rotor (18) are located outside surrounding the corresponding parts (21, 22) of the electromotor stator (19).

2. Hammer tool according to claim 1, characterized in that the electromotor (17) is a brushless multipolar AC-motor arranged to be fed with high frequency current.

3. Hammer tool according to claim 1 or 2, characterized in that the drive shaft (24) for the hammer mechanism constitutes the rotor-shaft of the electromotor (17).

4. Hammer tool according to any of the preceding claims, characterized in that the rotor comprises a fan (29) for cooling the electromotor (17) and the hammer mechanism (14).

5. Hammer tool according to any of the preceding claims, characterized in that the rotor comprises a bowl-shaped body (25) on the bottom (26) of which the rotor shaft (24) is attached for extending centrally through the interior of the body (25) towards the hammer mechanism (14) and on the inner wall of which the electromagnetically active parts (23, 49) of the rotor are located.

6. Hammer tool according to claim 5, c h a r a c t e r i z - e d i n that the bottom (26) of said bowl-shaped body (25) comprises fan blades (28) on the outside thereof.

7 Hammer tool according to any of the preceding claims, c a r a c t e r i z e d i n that the rotor shaft (24) comprises a gear wheel (36) for transmitting rotary movement to the working tool (16).

8. Hammer tool according to any of the preceding claims, c h a r a c t e r i z e d i n that the electromotor is a 8-polar asynchronous motor.

9. Hammer tool according to any of the preceding claims, c h a c t e r i z e d b y an electronic converter (38) mounted on board for transferring a low frequency voltage of an external electric power source to a motor voltage of high frequency.

10. Hammer tool according to claim 9, c h a r a c t e z e d i n that the converter (38) is arranged to be cooled by the rotor fan (29).

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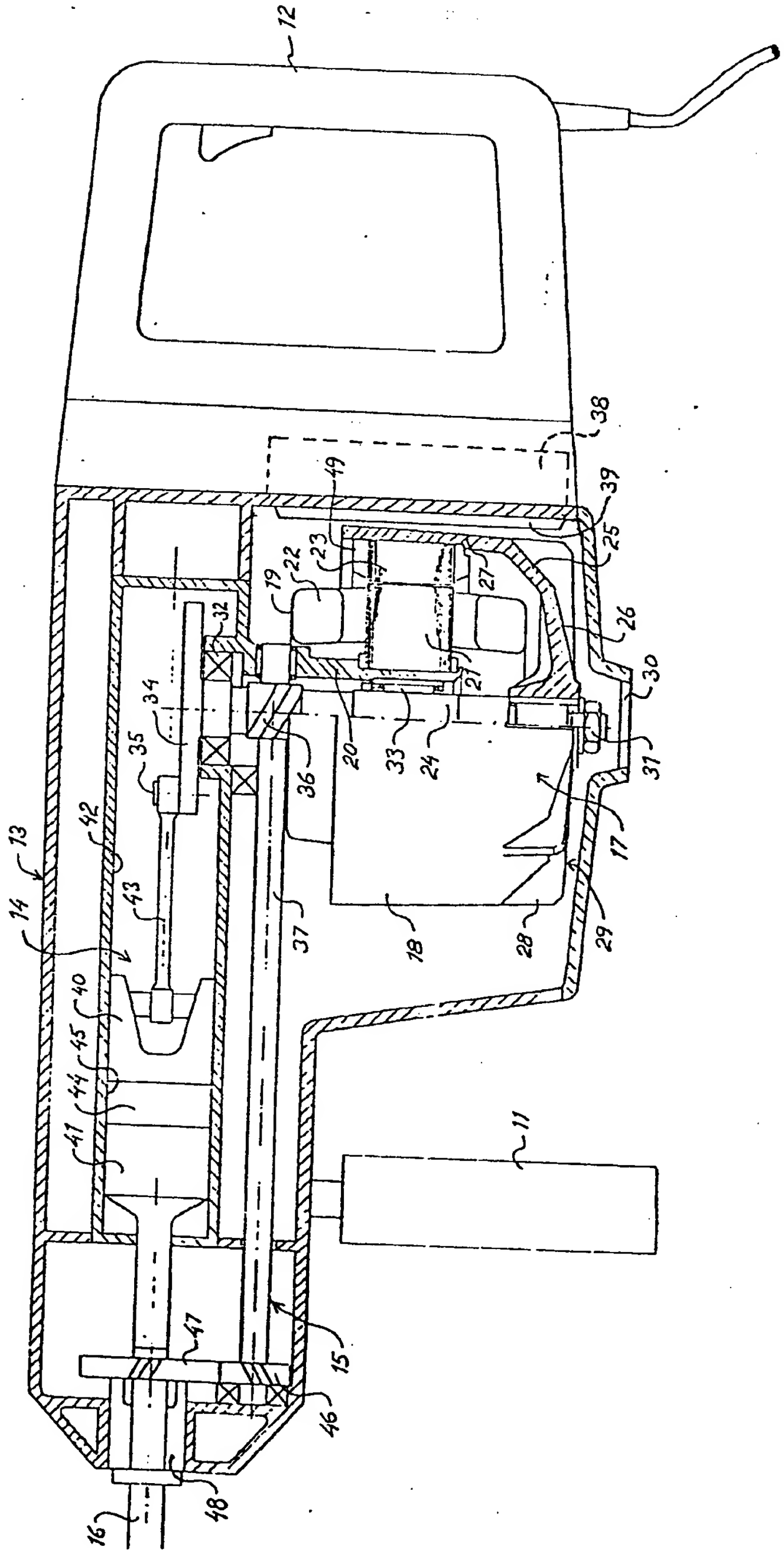

Fig. 1

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EUROPEAN SEARCH REPORT

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Application number

EP 83 85 0220

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	US-A-3 114 421 (SKIL CORP.) * Column 3, line 10 - column 4, line 3; figure 1 *	1,3,4,7	B 25 D 11/06 B 25 D 9/08 E 21 C 3/04 B 25 D 16/00 H 02 P 7/62A
A	US-A-4 130 770 (PAPST-MOTOREN KG) * Abstract; figure 1 *	1,5,6	
A	DE-B-1 196 608 (FRIEDRICH DUSS MASCHINENFABRIK) * Column 3, line 37 - column 4, line 7; figure 1 *	1,3,4,7	
A	US-A-3 530 350 (SKIL CORP.) * Column 2, lines 23-48; column 6, lines 14-32, 51-68; figures 3,6 *	2,9	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 25 D 11/00
B 25 D 16/00
B 25 D 9/00
E 21 C 3/00
H 02 P 7/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-01-1984	WEIHS J.A.

EPO Form 1503. 03.82

CATEGORY OF CITED DOCUMENTS

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